The Builder.

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A GENTLEMAN who was about to build a first-class residence in Edinburgh, to cost, we will say, 6,000*l.*, employed an architect of reputation, and took more than ordinary pains to insure a successful result. Being a wise man, he attached much importance to good ventilation and perfect drainage; he desired to have a healthy, dry residence, and to avoid spending half his days (and shortening them at the same time) in a mere receiver full of vitiated air, as many of us do; so the subject was well considered, and the most careful arrangements were made in the plans to effect his object. There were ventilating flues from the different rooms, and a mechanical arrangement was provided to draw out the vitiated air, and so to enforce the entrance of fresh,—a deep shaft being sunk for the passage of the weight which was to move a fanner employed, and other provisions made, of course at some cost. The drains, too, were well considered. Through the difference of level at back and front there were three stories below the street line in front, and these stories he wished dry and good in appearance, so that here again extra care was taken; the foundations were to be laid in cement, and the walls faced internally with worked ashlar of Binny stone, and painted. A very full specification was prepared and *printed*, extending to twenty-three folio pages; tenders were obtained from three or four builders,—the lowest was accepted (it was a very close fit); a clerk of the works was appointed, and proceedings were commenced.

The lower three stories, out of seven, were carried up, twelve or fourteen hundred pounds said to be expended, when an accident revealed the fact that all the mortar used had been compounded of *sea-sand*, brought direct from the beach. The specification was clear and precise, setting forth as follows, under the head—"*Lime and Sand.*—All the mortar is to be of the *best* quality, mixed together in proper proportions with *pure* spring-water. The lime will be from Gilmerton, and clean sharp *pit-sand only* is to be used."

After all the precautions to ensure dryness and an unexceptionable habitation, the proprietor was naturally alarmed, and protested vehemently against this departure from the contract.

The specification contained an arbitration clause, referring any differences which might arise between the parties to a well-known advocate (barrister); the works were accordingly stopped, and the matter put into the hands of the arbitrator, who has now been for many weeks taking evidence on the subject, and as yet has heard but one side,—although to us the question seems really to lie in a nutshell. The owner's architect and the architect's clerk of the works both depose that they were not aware that sea-sand was being used, or they would have stopped it earlier. If the contractor could prove that the architect had directed or formally approved of the substitution, the question would perhaps be altered, and the proprietor might have to seek his remedy from the architect, but this is not the case. The utmost that can be said is, that the architect might have stopped the use of the material earlier, if he had disapproved of it, but this is surely no reply. The contract is precise; nothing is left to discretion, and the architect was not bound to discover for himself, that sea-sand was being used, so far as respects the remedy of the proprietor against the contractor,—what the architect's duty was, as between the proprietor and himself, is another thing. He might have confidence in the contractor and so be led not to doubt that the latter was proceeding in accordance with a contract so clearly defined.

If a contractor, without the knowledge of the architect, covered a building with 6 lb. lead when he was bound to put 9 lb. lead, and was called on when the fraud was discovered to rectify it, it would surely be no answer to say that an architect was employed, and that he ought to have discovered that the lead was not of proper weight earlier,—that by not stopping the work he had approved of the substitution.

And now let us look, not at another part of the question, because, as it seems to us, it has little to do with the case we have put, but at what leads to the objection to the use of sea-sand, and was the ground-work of the stipulation in the contract. Is sea-sand the *best* material for mortar?—is it a fit material at all, when the mortar is to be used in a dwelling-house, where great dryness is required, without the most careful washing in fresh water, and bleaching? As the writer has said elsewhere, when pointing out that in the neighbourhood of the sea, stones and sand from the beach might be employed for concrete,—"Salt-water, or sea-sand, may not be used advantageously for plastering, or work exposed, in consequence of the affinity of the saline particles for moisture, which causes them to absorb it from the air." For underground or water-works, Smeaton and others assert that mortar prepared with them becomes harder than with the ordinary materials; it will harden, but not readily dry.*

Let us see what the authorities say on the effect of salt in mortar, and the value of sea-sand. Dr. Higgins, who wrote on calcareous cements in 1780, first pointing out that certain salts, such as sea-salt, &c., were found to injure the best mortar, continues,—"The cautions which our last-mentioned experiments suggest with regard to the use of water, are especially necessary in this country, where most of the wells and springs abound with one or more of the above-mentioned salts; and it is not to be presumed that the quantity of these contained in water which is used for culinary purposes, cannot be injurious in mortar, for I know that selenite, Epsom salt, the very deliquescent salts compounded of magnesia and marine acid, and calcareous earth and the same acid, may, together with a little sea salt, be natively dissolved in water, to the quantity of half an ounce to a gallon, without affecting the taste of it sensibly. When we consider the quantity of water necessary in slaking the lime, making the mortar, and wetting the thirsty bricks, and the smallness of those portions of salts whose injurious effects were discoverable in the course of one year, or in a shorter time, we find sufficient grounds for concluding that such saline waters will be found hurtful in mortar, before many years elapse, particularly where it is exposed to moisture. Indeed this has been already experienced of sea-salt, even in the small quantity of it introduced in mortar, when the sand is taken from the sea-shore." "When a choice can be made, rain water is to be preferred; river water holds the next place, land water the next, spring water the last; and waters noted medicinally or otherwise for their saline contents, ought not to be used at all in mortar."

The *Encyclopædia Americana* says—"Fresh sand wholly silicious and sharp is the best. That taken from the sea-shore is unfit for making mortar, as the salt is apt to deliquesce and weaken the mortar." In "Burrow's Cyclopædia" we find,—"Sea sand is found to be an improper material for mortar, which Mr. Anderson ascribes to its being less angular than other kinds;" while in "Rees' Cyclopædia" we have—"Sea-sand requires to be well washed in fresh water to dissolve out the salt, with which it is mixed, otherwise the cement into which it enters never becomes thoroughly dry and hard."

General Sir Charles Pasley, in his work on "Limes and Calcarious Cements" (p. 60), after mentioning some experiments on cement mixed with salt water says,—"Hence, as salt is certainly unfavourable, I would never mix cement with salt water, except in case of absolute necessity." Mr. Gwilt, in his "Encyclopædia of Architecture," remarks,—"If pit sand only can be procured, it should be repeatedly washed, to free it from the earthy and clayey particles it contains, until it becomes bright in colour, and feels gritty under the fingers. When the architect is obliged to use *sea-sand*, it must be well washed in fresh water until the salt is entirely removed: otherwise the cement for which it is used will never dry;" and Mr. Hosking, in his article on "Building," in the "*Encyclopædia Britannica*," says,—"Particular attention must be paid to cleansing the sand to be used for mortar, of every particle of clay or mud that may adhere to, or be mixed up with it. Sea-sand is objectionable for two reasons: it cannot be perfectly freed from a saline taint, and the particles are moreover generally rounded by attrition, caused by the action of the sea, which makes it less efficient for mortar than if they retained their natural angular forms." And again,—"Rain, or any other soft water, should be used for the purpose of making mortar, and not spring or hard water, though any other may be preferred to what is *brackish* even in the slightest degree."

Endeavours have been made, and with some success, to shew that as sea-sand consists of nothing else but particles of flint stones, washing and bleaching will remove all saline taint, and render it an admirable material for mortar: and respectable builders have given their opinion, that, when washed and laid out to dry in open yards exposed to the weather, it will, with *coal-ashes* and lime, make a mortar which, though it may not become dry so *fast* as mortar made with river-sand, will ultimately become perfectly so, and be free from any inconvenience.

We are not disposed to question this: only get rid of the salt, and sea-sand will make mortar fit for any purpose. The difficulty is to do this thoroughly; and so long as there remains any salt in it, so long will there be a tendency to dampness and most serious inconvenience. We know a house on the sea-coast where a wall was built to separate two rooms, with mortar made, as the architect afterwards ascertained, from *washed* sea-sand, and the

* "Prize Essay on Concrete," in "Transactions of Royal Institute of Architects," Vol. I.

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